predisposing it to hemorrhage may possibly be a partial explanation, without, of course, having any data in its support.

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MOUNTAIN SICKNESS.

By August Strauch, M.D.,

CHICAGO, ILLINOIS.

Travelling and sojourning among mountains is a prominent feature of modern life, because of the increasing enthusiasm for Nature's grandeur and the growing appreciation of the hygienic factors of the climate of high altitudes by the healthy as well as by the sick. The number of resorts and sanatoria in the regions of high mountains is ever increasing, to combat various diseases, successfully, as the empiricism of centuries has proved.

But as the advances became bolder, penetrating into the highest altitudes, partly for touristic purposes, partly for scientific exploration and research, and as mountain wandering became more common, due to successful geographical exploration and development of railways, that added to the accessibility of the higher mountain systems, experiences accumulated, that pointed to harmful effects and dangers from the climate of high altitudes above a certain zone. The study of these effects, that high altitudes exert upon the human organism in a physiological and pathological sense, is highly interesting from a scientific point of view; it also has an important bearing upon the practical question. How may the hygienic factors of high lands be utilized to the best advantage by both the sick and the healthy, and what are the indications and contraindications for high altitudes?

The increasing numbers of Americans that resort to the European Alps and to the high elevations of the Rocky Mountains in our Western States make this subject one of concern to all physicians. The Federal Government of Switzerland considered it of great practical importance to ascertain, when the construction of mountain railways to the highest summits of the European Alps was contemplated, where the danger line was, at what altitudes injuries to the health of visitors might presumably be inflicted, and which individuals might be seriously imperiled. In connection with these studies, Kronecker's account of his observations in the pneumatic chamber, and on mountains, is one of the most important works written on mountain sickness. But also reports were then available of experiences made on the high mountain railroads of the American continent, especially on the famous Oroya Railroad in the Peruvian Cordillera, the highest railroad of the earth, reaching the considerable elevation of 15,800 feet, and also of experiences on the cog-wheel railroad to the summit of Pike's Peak, 14,200 feet.

HISTORICAL REMARKS. The exploration and conquest of the high European summits had not yet commenced when the Spaniards, on their conquering expeditions into the equinoxial regions of ancient American civilization, penetrated into the mountain chains of the Great Andes, and advanced to altitudes where they could not escape the serious effect of the rare climate upon the health. Numerous are the records of this period of conquest, vividly narrating the great agonies and miseries which the bold pioneers had to endure on the high passes of the great Andes.

Perhaps the most interesting are those of the Jesuit, Pater Accsta, who, as the first one in his *Historia naturale de las Indies*, gives us a detailed account of the symptom complex which he named mountain sickness.

On his expedition to Peru, at the altitude of about 14,800 feet, when passing the Periacaca on his mule, he was seized by an attack of discomfort, with abdominal cramps and the vomiting of food, mucus, and bile, and finally blood; his companions suffered from similar attacks, and also from diarrhea. It deserves to be mentioned that he ascribed these symptoms to the rarity of the atmosphere.

Neglecting a few records from the following period, we see their number rapidly grow at the end of the eighteenth century, the beginning of the period of great scientific explorations of the higher mountain systems of our earth, relative to their geography, orography, geology, etc.

De Saussure relates that, during his famous expedition on the summit of Mont Blanc in 1787, an overwhelming sleepiness, which defied cold, wind, and snow; lethargy, lassitude, vanishing of muscular power, and vomiting was experienced among the participants of the toilsome ascent. He had to take breath every ten to fifteen steps, being compelled by exhaustion to sit down. When trying to rise up again his legs failed. The fatigue, which he explained by rarity of air, was overwhelming. He suffered from intense heart palpitation, beating of the arteries of the head, much dyspnea, a feeling of faintness, and complete loss of appetite. In his records he at the same time points to the remarkably speedy recovery from the exhaustion after a short rest of two to three minutes, so differing from the symptoms of exhaustion in low altitudes due to actual overexertion.

On the summit of Mont Blanc, 15,800 feet, where he made meteorological observations, he suffered at rest only from slight nausea, but every attempt at reading his recording instruments in the rarefied air was followed by intensive dyspnea as a consequence of the short suspension of respiration due to the intentness required for the observation.

In the beginning of the nineteenth century, Alexander von Humboldt[4] undertook his well-known scientific expeditions to Central and South America, where he explored the great mountain chain of the Cordillera, in its average height, the second on earth. Thrillingly he depicts the sufferings which befell him at the altitude of about 5800 meters (19,000 feet), during his ascent of the Chimborazo volcano, that, towering with its five summits, reaches the height of 6250 meters (20,600 feet).

"The Indians, with one exception, abandoned us at an altitude of 15,600 feet. Prayers and threats were alike vain; they declared they were suffering more than we. When the height of 5800 meters (19,000 feet) was reached, all of us by degrees began to feel very ill at ease and to suffer from great nausea; the vomiting was accompanied by dizziness, and was more distressing than the difficulty of breathing. The companions bled from gums and lips, and the conjunctivas of their eyes likewise were bloodshot."

Once when upon the Pinchincha, at an elevation of 13,800 feet, he was seized with such violent pain in the stomach and overpowering giddiness that he sank upon the ground in a state of insensibility.

Vivid pictures of self-experienced sufferings during travels among the great Andes we owe also to Poeppig, of Leipzig, Tschudi, Whymper, Conway, and others.

Tschudi,[13] who travelled in Peru from 1838 to 1842 (*Travels in the Great Andes*, translation from the German), depicts one of his attacks of mountain sickness at an altitude of about 4500 meters (14,800 feet) in the Cordillera.

"My panting mule slackened his pace and seemed unwilling to mount a rather steep ascent. To relieve him I dismounted and began walking at a rapid pace. But I soon felt the influence of the rarefied atmosphere, and I experienced an oppressive sensation, which I had never known before. I stood still for a few moments to recover myself and then tried to advance; but an indescribable oppression overcame me. My heart throbbed audibly, my breathing was short and interrupted. A world's weight seemed to lie upon my chest; my lips swelled and burst; the capillary vessels of my eyelids gave way, and blood flowed from them. In a few moments my senses began to leave me. I could neither see, hear, nor feel distinctly. A gray mist floated before my eyes. In this half senseless state I lay stretched on the ground until I felt sufficiently recovered to remount my mule."

Dwelling upon the subject of mountain sickness, he mentions the fact, that high altitudes are very fatal to cats. At the elevation of 18,000 feet above the sea, these animals cannot live; numerous trials have been made to rear them in the villages of the upper mountains, but without effect, for they die soon here under convulsions. Horses and mules suffer like man.

It is only more lately that experiences as to mountain sickness in the great mountain systems of other geographical positions have been gathered, a fact which may be explained by the circumstance that the great Andes of Peru and Ecuador are only to a small extent covered with eternal snow and glaciers, on account of their equatorial latitude, and for that reason they have been inhabited from time immemorial to very considerable elevations, and, therefore, are comparatively easy of access.

The temperate climate renders it possible, as high as Quito, 2850 meters (9400 feet), for bananas, palms, and eucalyptus to grow on protected places, and an abundant flora of alpine flowers ascends to an elevation of 4000 to 4800 meters (13,000 to 15,800 feet).

Thus, numerous records have been made of observations on mountain sickness during various ascents of the summits of the Caucasus, the Ararat, 5200 meters (17,000 feet), of Mount Loa, 4170 meters (13,760 feet), etc., and finally during travels on the great Central-Asiatic high plateaus of Thibet, and in the Himalayas (Sven Hedin, Guillermod, Kronecker, and others).

The authors emphasize the fact that the higher the altitudes the greater is the difficulty of walking and breathing, and that physical exertion even of a minor degree augments the suffering in an extraordinary way.

The brothers Schlagintweit, well possessed of an extraordinary resistance against the air of high altitudes, who on their scientific mission to high Asia succeeded in carrying their climbing as high as 6800 meters (22,000 feet), corroborate the fact that the native Hindoo coolies, the carriers of burdens, are often more affected than the European travellers who are riding. "Our guides and servants," he states, "dropped upon the snow, declaring they would rather die than take one step more."

Whymper,[11] the well-known English high-tourist, who, among mountain climbers, has devoted more particular attention to mountain sickness, experienced manifestations of mountain sickness, as related in his work on the Chimborazo in the region of 16,000 feet above the sea, corresponding to a barometric pressure of 400 mm. After a meal he and his two companions were suddenly seized with an alarming attack of the malady, with great weakness, fatigue, thirst, headache, a feeling of fever, extreme dyspnea, heart palpitation, and acceleration of the pulse. He adds this remark: "Our incapacity was neither due to exhaustion nor to deficiency of bodily strength, but to the rarity of air."

DEFINITION AND SYMPTOMS DURING WORK. Scrutinizing the accounts of pathological phenomena that occur during travels in high mountains, in order to define the clinical entity of the mountain sickness proper, we ought to regard only manifestations that in a direct or specific way are due to the high elevation itself, and we must subtract those that may come from causes also operative in lowlands, that is, symptoms of an actual overexertion, snow blindness, erythema solare, etc.

The mountain sickness befalls some individuals at a lower, others at a higher altitude, but no one who proceeds beyond a certain elevation, the critical line, escapes the malady. An elevation of 3000 meters (10,000 feet), or even less, might provoke it in some, others may escape the symptoms up to 4000 meters (13,000 feet), or even 5000 meters (16,500 feet), while only very few, possessed of unusual resisting power, can without much distress venture upward to 6000 or almost to 7000 meters (19,000 to 23,000 feet).

The symptoms of mountain sickness depend not only on the nature of the individual, but also on various intricate contingencies, especially on physical exertion, that is, on whether the ascent is performed by climbing or by passive carriage on horseback, sedan chair, or mountain railroad.

In the former case, as might be expected, the symptoms make their appearance in lower altitudes, and involve those organs which are under the greatest strain, namely, the heart and muscles. Marching or climbing within the critical zone causes fatigue, faintness, and physical prostration, that often set in rather suddenly and after even a comparatively small amount of physical work; they may be so severe as to necessitate rest, or even to lie down; the failure of the muscles to act may completely incapacitate the traveller for movement. But in not extreme elevations, a few moments of repose apparently restore the former strength, and with new muscular vigor one takes up again his climbing, to be forced, however, to halt anew after perhaps only a few steps.

The great intensity of the fatigue, the readiness with which it appears upon even moderate muscular activity, which in low altitudes hardly would have any perceptible effect, distinguish it strikingly from ordinary fatigue, called forth by actual overexertion.

The strange feeling of faintness and the quick exhaustibility in mountain sickness, therefore, is not identical with ordinary exhaustion by excessive muscular work, but it is generally admitted to be due to the deficiency of oxygen in the rarified air, that cannot satisfy the body's increased demand on account of the increased work of the heart and muscles.

But speedy reparation takes place for when at rest, the consumption of oxygen falls off rapidly.

To the above-mentioned fatigue and weakness are added heart palpitation, dyspnea, oppression of the chest, vertigo, anorexia, headache, often ringing in the ears and impairment of hearing, nausea, vomiting, great drowsiness, and sometimes syncopal attacks.

That cases of genuine overexertion with the well-known trail of serious symptoms, such as acute dilatation and insufficiency of the heart, feeble dicrotic "fatigue" pulse, etc., are encountered in mountains more frequently than in lowlands is not to be wondered at, as mountaineering represents intense muscular work, often carried beyond the limits of endurance and capacity for muscular exertion, in the case of untrained summer tourists, either from necessity or temptation.

But these symptoms are not from mountain sickness primarily, being similar to those occurring in overexertion in lowlands; though more grave significance is attached to them on account of the rarity of oxygen in higher altitudes. Recovery takes place more slowly and exitus lethalis is more liable to be the issue.

In pronounced cases of mountain sickness, as, for instance, in very high altitudes, psychical manifestations may supervene. The will power is then extinguished, mental lassitude prevails, and in consequence a complete indifference toward the dangers of snow, cold, storm, etc., gets hold of the individual, "who would rather die on the spot than make an attempt to proceed."

States of mental excitability, as well as states of physical depression, are encountered; increased liability of the emotions tending to quarrelsomeness or hilarious expansivity. This is well known to the guides and tourists of the Alps. Cyanosis, blue circles around the eyes, bleeding from nose, lips, gums, lungs, and stomach, and constipation or diarrhea, are other symptoms referred to in the records on mountain sickness.

Author's Experience. I experienced the effect which comparatively moderate altitudes exert, in tending to lower physical endurance, on the high plateau of the Yellowstone geysers, the elevation of which is about 7000 feet, where fast marching or, more markedly, running on a horizontal level for a short distance such as 300 to 350 yards, called forth a very high pulse rate (150 to 160) and dyspnea, that I never experienced at lower levels with such insignificant muscular work. Many tourists, although trained in various sports, expressed their wonderment at how quickly fatigue arose when they wandered on the fairly horizontal plateau of the geysers.

When I had reached the critical line, in ascending the volcano Etna (10,800 feet), at an altitude of about 9600 feet, the rarefied atmosphere made itself felt to me in a considerable degree; in spite of a good night's rest in the observatory at the base of the central cinder cone (9650 feet), the final stage of the ascent was made under great fatigue, heart palpitation, very high pulse rate and difficulty of breathing, so that I was forced to halt every fifteen to twenty-five steps, but restoration of apparently full muscular strength promptly occurred after a rest of only one to two minutes. It was obvious that exhaustion due to actual overexertion was out of the question, for the smooth cinder sides of the cone, inclined at a slope of about 30 degrees, were rather compact on account of previous rains, so offering a splendid foothold. On the top, at rest, I felt perfectly well.

Perhaps tourists here show manifest symptoms of mountain sickness, such as lassitude, headache, apathy, nausea, vomiting and dyspnea at the slightest movement, etc., more frequently than on other mountains of the same altitude. This is possibly due to the fact that the ascent begins practically at sea level, and is performed without intermediary stages.

SYMPTOMS OF MOUNTAIN SICKNESS WITHOUT THE INFLUENCE OF EXERTION. As the influence of the muscular exertion of climbing, or of occasional actual overexertion, renders the clinical picture more complex, and, therefore, rather difficult of analysis, we may study with great advantage the syndrome that arises when a high altitude is reached passively, that is, without physical work, as by mountain railroad, riding on horseback, or by ascending in a balloon. Here symptoms are forthcoming that at first point to disturbances of the brain functions; such as headache, dizziness, trembling, apathy, lassitude, and sleepiness, to which are added general weakness, often tinnitus aurium, nausea, and vomiting, sometimes obscuration of the vision and, if aggravated, even syncope.

Moderate exertion, as wandering on a level, or to a greater degree climbing, increases the manifestations, or if they have not been developed, calls them forth; dyspnea sets in, and the pulse quickly rises to a very high rate. The disturbances during high balloon ascensions are similar. However, the symptoms mentioned, as a rule, do not appear immediately after the arrival on the height, but may develop gradually, that is, within hours, the speed of the passive ascent having an important bearing. Complete loss of appetite also prevails; thus, the whole picture resembles the state of acute anemia.

AUTHOR'S EXPERIENCE ON PIKE'S PEAK. In 1908 I made an ascent of Pike's Peak (14,200 feet) by the cog-wheel railroad. The trip to the summit took one and one-half hours. After arriving, about noon, my pulse rate at rest was increased to 70, the respirations to 30. Attacks of dizziness, sensations in the ear, tremor of the hands, and a desire of more frequent and deeper respiration, often with sighing, were the clinical manifestations. Moreover, dyspnea and dizziness became aggravated and the pulse rate very much increased by ridiculously insignificant exertions, as by leaping over the granite blocks on the summit, by fast walking, and especially by stooping; I was unable to tie my shoes without pausing in between to gasp for air; and oftentimes I had pulsations in the eyes. I passed in bed an entirely sleepless and miserable night, on account of malaise and attacks of slight oppression of the chest. The pulse rate was between 90 and 100, the higher rates after slight movements. Most of the night there was a pronounced periodical type of breathing, approaching Cheyne-Stokes' phenomenon, namely, long pauses, during which my drowsiness increased, were followed by a series of a few very deep inspirations, which in their succession gradually became superficial ones.

The following day the attacks of dizziness and the pulsations in the bulbus had improved.

The lowest altitude in Colorado at which I experienced dizziness, that at the same time caused uncertainty in walking, was at 10,800 feet, when going over Marshall Pass by railroad.

Under physiological conditions in low land indications of a periodical respiration can only be observed, during sleep, when the depth of the respiratory movements, gradually increasing and decreasing, forms thus connected groups.

This physiological phenomenon is explained by the assumption of a lowered irritability of the nervous respiratory centre during sleep. In high altitudes, however, this periodicity is more pronounced, and the respiratory curves are also undulating while awake. Mosso observed it on the summit of Monte Rosa (15,300 feet) in almost everybody.

The types of the respiratory periodicity in high elevations are various, as illustrated in Mosso's monograph,[9] and include also characteristic Cheyne-Stokes' phenomenon. The occurrence of the latter in very high altitudes, however, has not the ominous significance that otherwise is attached to it.

PROGNOSIS. Although the malady may have aggravated manifestations with great discomfort and distress, in moderate altitudes these, with time, especially when at rest, tend to diminish rather than to increase, and the danger to those otherwise healthy, is generally slight. However, a few cases of exitus lethalis are ascribed to the direct effect of the rarefied atmosphere; the French scientists Sivel and Crocé-Spinelli, lost their lives in their balloon at an altitude of about 8600 meters, while Tissandier, the third participant of the ascension, fell unconscious and narrowly escaped.

ACCOMMODATION AND ACCLIMATIZATION. As a rule, in the course of days or weeks, a certain degree of acclimatization takes place.

The laborers occupied with the boring of the Mont Blanc tunnel suffered only in the first weeks from short breathing, drowsiness, loss of appetite, and great exhaustibility.

There are many permanently inhabited places on the slopes and high plateaus of the Andes up to the considerable elevations of 13,000 to 15,000 feet; and the mines here of Villacota, situated at an altitude of 5000 meters (16,500 feet) are operated by indigenous and foreign laborers. The natives of the places are capable of speedy marching in heights where newcomers from Lima suffer great distress.

In Quito, 2850 meters (9400 feet), a city of 50,000 inhabitants, bull-fights are performed, and in Potosi, 4000 meters (13,200 feet), "the girls can dance throughout the night as in our country."

However, it must be mentioned that the adaptibility of the human organism is limited, the acclimatization being effective only in those altitudes in which one stays permanently, while failing completely in extreme heights as at 6000 meters (19,800 feet).

CAUSES. The physiological and pathological manifestations observed in high altitudes, as described, can experimentally be produced by gradually rarefying the atmosphere within a pneumatic chamber, imitating thus the decrease of the barometric pressure and of the amount of oxygen with the increasing altitude. Such experiments, "artificial ascents," under various conditions, have been made by Paul Bert,[7] Mosso,[8] Reynard, Schroetter, Zuntz, Löwy, and others on men and animals, as on monkeys, cats, dogs, guinea-pigs, birds, etc., to elucidate the etiology and pathogenesis of mountain sickness.

As the air in the chamber gets decompressed, the individual in lying posture first notices, perhaps, a slight feeling of pressure of the head, buzzing in the ears, and an increasing tiredness and drowsiness, which with the proceeding diminution of the air, more and more becomes irresistible. Slight exertion, for instance, sitting up, handling apparatus, or stooping, aggravates the fatigue and faintness considerably, the muscular strength fails, dizziness and ataxia occur, the eyesight is dimmed, the psychical functions—for instance, the memory, attentiveness, concentration, etc.—are impaired, and headache, dyspnea, heart palpitation, sometimes also nausea, manifest themselves. After lying down again, or by inhalation of oxygen, the symptoms improve or may disappear entirely.

Animals get less lively, motionless, often vomit, and fall into a doze or unconsciousness.

The muscular ataxia in much rarefied air shows itself also in alterations of the handwriting. Of this, H. v. Schroetter, at an air pressure of 240 mm., after a short interruption of oxygen inhalation, has given a striking example; his hand became hardly legible.

Zuntz[17] reports the observation of similar alterations of the handwriting of Caspari and Mueller on the summit of Monte Rosa, 4650 meters (15,300 feet), and, according to him, very marked is the loss of control of the voluntary muscles shown in the meteorological notes of Berson and Suering[1] during their well-known balloon ascent in 1901, whereby they reached the highest altitude as yet obtained by man—10,800 meters (35,600 feet).

The theory at the present time accepted by most investigators as to the causation of the malady in high altitudes holds the rarity of the oxygen in the atmosphere responsible. It causes a diminution of oxygen in the blood, a state of "anoxhemia barometrica," as Jourdanet, the founder of this theory, has termed it, and consequently a kind of asphyxia of the tissues.

Inhalations of oxygen in the pneumatic chamber and in the balloon have a beneficial effect, retarding or relieving the symptoms, and rendering man capable of withstanding degress of air rarity or altitudes which otherwise would be fatal.

During high ascensions, after the first draughts of oxygen the strength of aëronauts returns, fainting fits disappear, the beginning psychic lethargy changes to clear consciousness, physical work can be done again, etc.

With oxygen inspiration, Paul Bert[2] could submit himself in a metal cylinder to a decompression of the atmosphere which corresponded to altitudes of the summit of Chimborazo and of Mount Everet, the highest mountain on earth.

Mosso, in his experiments, endured thus an air pressure corresponding to an altitude of 10,500 meters (34,600 feet), and Suering in his balloon ascension could with oxygen supply make the record of an elevation of 35,600 feet, the highest as yet obtained.

In connection with such facts arises the question, interesting from a physiological and biological standpoint, as to the maximum altitude compatible with human life.

H. v. Schroetter[12] (Vienna), by calculation, places the limit at about 12,000 meters (39,000 feet), for here even inhalation of pure oxygen would be without avail, because at such an altitude the partial pressure of oxygen in the lung alveoles would be too low to allow its absorption.

The great exhaustibility by muscular work in high mountains has its analogy also in the experiments of Reynard, 1894, who found that a guinea-pig, forced to move about within the recipient of an air pump, at an air pressure corresponding to 4600 meters (15,000 feet) altitude, very soon became exhausted and fell, while another guinea-pig, left at rest, fell and seemed to die only at an air pressure which corresponded to an altitude of 8000 meters (26,400 feet). When air was quickly admitted, both animals recovered, the first one, however, very slowly.

Anoxyhemia gives a satisfactory explanation for the fact that mountain sickness appears sooner during muscular work than at rest, as during ordinary mountain climbing the demand for oxygen is increased four to five times more than the amount demanded during rest. Therefore altitudes such as have been reached in balloons can hardly be obtained by climbing, and the climbing up to almost 7000 meters (23,000 feet) in the Andes and Himalayas, as done by Conway,[3] Zurbrigger, and Stuart Vines, although with difficulties, must be considered as an extraordinary feat and as a proof of a very rare resistive power.

The accumulation of pathological products of metabolism, that gradually develop on account of the insufficient oxygen supply in the blood and betray themselves not only in the increased output of incompletely oxidized substances in the urine, but also by the decrease of the alkalinity of the blood (Zuntz), may account for the fact that the effects of high altitudes often are cumulative, the manifestations often appearing not immediately upon arrival on the summit, but gradually within hours, or even posthumous, so to speak, during the descent.

The acclimatization to high altitudes is principally due to an increase in the total amount of hemoglobin as the oxygen carrier, and to an alteration of the respiration and circulation, in a regulative sense.

As a matter of fact, the natives of the high plateaus of the Andes show a remarkably higher number of erythrocytes than the inhabitants of lowlands, namely, 6,000,000 to 8,000,000 in 1 c.mm.; a gradual increase of the number of red blood cells is also observed in man and animals, who temporarily remain in high altitudes.

Paul Bert, in 1882, found that the blood of the Peruvian mountain sheep (llama) was capable of absorbing much more oxygen than was the blood of sheep living on the plains.

Miescher[7] suggested, and Zuntz and Löwy proved by experiments on animals, that the air of high elevations stimulates the function of the red bone marrow; the total amount of blood and hemoglobin which could be extracted from the body being acually increased.

Jaquet[6] obtained quite similar results by keeping rabbits in chambers in which the atmospheric pressure was artificially reduced.

Humboldt found a remarkable increase in the capacity of the thorax among the inhabitants of the great Andes, and Dr. C. T. Williams[15] likewise observed an actual increase in the thorax as the result of a residence in high mountain resorts.

Besides the diminution of oxygen in high mountains, some accessory factors, the sum total of the other climatic factors, including the minute electric conditions of the atmosphere, seem to have a certain bearing upon the outbreak of the malady, although not yet well understood. Intensive cold temperatures, dry air, clear skies, when, as it is found, the ionization of the atmosphere is increased, and also strong sunshine are, according to the general experience, largely contributory to the provocation or aggravation of the symptoms, while vaporous air, cloudy skies, and winds tend to retard or lessen them. A very frequent statement is made that during the night's repose the symptoms become more distressing. Likewise very remarkable is the fact that the symptoms of mountain sickness may appear especially on certain locations of predilection, as is well known on the Alps and the Andes, though other regions of the same mountain range, or of the same mountain even situated higher, may allow mountaineering without suffering. Such places of predilection often are narrow couloirs, ravines, trough-shaped depressions of the niveau, in short, locations more or less protected from the motions of the air, and, therefore, not ventilated. On such places, according to Elster, Geitel, and Zunts, a high ionization, unipolarity, and radio-activity of the air exist as the result of the stagnation of the radio-active emanations from the soil. Saake[10] found the air of high altitudes to possess three times the amount of radio-active emanations than the air of lowlands, and it is known that certain soils and minerals, for instance, those containing pitchblende or some other metal ores, some clays, etc., emit a greater amount of emanations than others. But further investigation and advance of our knowledge of the influences which the minute electrical and other physical conditions of the atmosphere exert upon the human body, as yet hypothetical, will be necessary before we can pass on the problems that the above-mentioned facts involve. Obscurity prevails also in regard to an explanation of the circumstance that in the different mountain systems of our globe this sickness begins at different altitudes; in the European Alps, for instance, at about 3000 meters (9900 feet) many men suffer, while in the Andes the critical zone is located at about 4000 meters (13,000 feet), and in the Himalayas at about 5000 meters (16,500 feet).

Although the hypothesis that anoxyhemia is the cardinal cause of mountain sickness is at the present time accepted by many authorities, still because there seem to be difficulties in applying this theory to some phenomena, other authors have attempted explanations starting from different points of view.

Kronecker,[5] for instance, assumed that the diminution of the air pressure calls forth a hyperemia and blood stasis of the lungs, which is followed by an affection of the cardiac function and circulation; however, this mechanicophysical hypothesis has no foundation in the findings made by other authors.

Mosso,[8] who, in the Regina Margherita hut on the summit of Monte Rosa, made numerous observations and experiments, gathered experiences that led him to the conviction that the deficiency of CO_2 in the blood, the aknapia, as he names this condition, in contradistinction to asphyxia, was the agent provoking mountain sickness and not the lack of oxygen, the asphyxia of the tissues.

Zuntz,[17] Löwy, Mueller, and Caspari, in their recent work on the climate of high altitudes, are quite opposed to Mosso's ingenious theory, and the greater weight of evidence substantiates the theory of the anoxyhemia of Jourdanet and Bert.

As it gives the key to a better understanding of the processes of acclimatization, so it likewise enables us to comprehend the differences of the resistance power of the different individuals. In the first place, this depends upon the varying amount of hemoglobin, the oxygen carrier, and upon the form of respiration of the individual. Exact observations and systematic experiments made by Löwy, Zuntz, and others established the fact that deep respirations greatly increase the partial pressure of the oxygen within the lung alveoli, even with unchanged oxygen tension of the outer inspiration air, thus increasing the supply of the blood; simultaneously the mechanical acceleration of the circulation by stronger respiratory movements assures a better oxygen supply of the various tissues.

Therefore, in high altitudes, persons with a type of deep respirations are at a great advantage over persons of flat breathing; this type of respiration being essentially prophylactic against the acute affections of the human organism by a greater decrease of the barometric pressure. On the other hand, a weak nervous system, lack of sleep, disturbances of the functions of the alimentary canal by overeating, alcoholism, etc., increase the liability of the malady and aggravate its character.

CONTRAINDICATIONS. Higher altitudes ought to be avoided by persons whose adaptability, on account of certain organic diseases, is below par; for instance, general weakness, or grave degrees of anemia and emphysema pulmonum.

High elevations, even such of 3500 feet, should be considered dangerous, especially for persons suffering from weak heart action, valvular disease, particularly mitral insufficiency and myocarditis, and such pathological changes of the bloodvessels as are found in arteriosclerosis, aneurysma, and nephritis chronica, with high blood pressure.

Most emphatically, in doubtful cases, muscular exercise must be cautioned against until the heart has, to some extent, adapted itself to the changed conditions.

Zangger[16] directs special attention to the dangers of rapid ascent by high mountain railways for elderly persons suffering from nephritis or arteriosclerosis, since syncope, angina pectoris, asthma cardiacum, and apoplexy are possible occurrences also on the return to the lowlands from these excursions.

PROPHYLAXIS AND THERAPY. In summing up the experiences and the theoretical points, we must accord great prophylactic and therapeutic importance to a sufficiency of the oxygen supply to the organs.

Wherever feasible, some means of transportation (horse, mule, railroad, sedan chair, etc.), should be preferred to exhaustive active climbing, although the speed of ascent by mountain railroads might for many persons involve an objectionable feature.

Good training of the muscles, heart, and respiratory organs in moderate elevations previous to climbing to higher altitudes is paramount to increasing the resistance power; mounting should be done gradually and leisurely by small stages, so that there may be no abrupt transition, and the climber should be in good physical condition, avoiding extreme fatigue and exertion, which, like sleeplessness, increase the disposition to mountain sickness. The respiration should be deep, the nourishment sufficient and suitable, avoiding digestive disturbances, which by meteorism are apt to interfere with deep respiration.

When travelling by railroads that cross high altitudes, oxygen should be at the disposition of the persons suffering from manifestations, or, as Melinovski, chief engineer of the Oroya Mountain railroad, suggested, cars hermetically closed should be attached to the train, in which a suitable air pressure could be maintained artificially.

When the mountain sickness has set in, absolute rest, deep breathing, or oxygen inhalation will bring temporary relief, otherwise, with more serious symptoms, descent into lower altitudes must be resorted to before a new ascent can be considered.

Against the headache, antipyrine, phenacetine, etc., may be tried.

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REVIEWS

MODERN TREATMENT: THE MANAGEMENT OF DISEASE WITH MEDICINAL AND NON-MEDICINAL REMEDIES. By American and English Authorities. Edited by HOBART AMORY HARE, M.D., Professor of Therapeutics and Materia Medica, Jefferson Medical College, Philadelphia; Physician to the Jefferson College Hospital. Vol. I; pp. 930; 105 engravings, and 31 full-page plates. Philadelphia and New York: Lea & Febiger, 1910.

THE notable advance which the past twenty years has brought about in our knowledge of the etiology and management of disease has worked radical alterations in therapeutic procedures. Much, however, of this recent knowledge has been disseminated in a form unavailable for ready application by the practising physician. Therefore, a work such as the one under consideration has become a necessity, and its timely appearance must be regarded with decided satisfaction.

The first part of Vol. I deals with general considerations of drug therapy, and embraces chapters on pharmacology, prescription writing, and the toxic effects of drugs. In the opening chapter, H. C. Wood, Jr., discusses the relationship of modern pharmacology to practical therapeutics. Although he emphasizes the value of pharmacology in medicine, he unfailingly recognizes the limitations of drug therapy. In his excellent summary of the physiological action of drugs, he wisely groups drugs according to their clinical uses rather than into a pharmacological classification.

The chapter on prescription writing, contributed by Hunsberger, is worthy of comment. Written by a skilled practical pharmacist, it is replete with helpful suggestions. Many of the perplexing technical details that frequently confront the physician in his efforts to combine drugs to the best advantage are here explained.

The second part of this volume considers non-medicinal measures for combating disease. It is the largest division of the book, and properly so; embracing nearly four hundred pages, it stands in striking contrast to the hundred odd pages previously devoted to drug therapy. It is impossible, in a review of this length, to take up separately the various important subjects discussed in each chapter. Suffice it to say that in every instance the contributor is one whose ripe personal experience and broad knowledge is such